

What is claimed is:

- 1 1. A method for capping over a copper layer,
2 comprising the steps of:
3 forming the copper layer overlying a substrate;
4 performing a first plasma treatment on a surface of the
5 copper layer;
6 performing a second plasma treatment on the surface of
7 the copper layer; and
8 capping the copper layer with an insulating layer.
- 1 2. The method as claimed in claim 1, wherein the
2 first plasma treatment is performed using hydrogen as a
3 reacting gas.
- 1 3. The method as claimed in claim 2, wherein the
2 first plasma treatment is performed at about 300 to 500°C.
- 1 4. The method as claimed in claim 2, wherein the
2 first plasma treatment is performed for about 5 to 15
3 seconds.
- 1 5. The method as claimed in claim 2, wherein the
2 first plasma treatment is performed at a pressure of about 3
3 to 6 Torr.
- 1 6. The method as claimed in claim 1, wherein the
2 second plasma treatment is performed using ammonia as a
3 reacting gas.
- 1 7. The method as claimed in claim 6, wherein the
2 reacting gas further comprises nitrogen.

1 8. The method as claimed in claim 6, wherein the
2 second plasma treatment is performed at about 300 to 500°C.

1 9. The method as claimed in claim 6, wherein the
2 second plasma treatment is performed for about 5 to 20
3 seconds.

1 10. The method as claimed in claim 6, wherein the
2 second plasma treatment is performed at a pressure of about
3 2 to 4 Torr.

1 11. The method as claimed in claim 1, wherein the
2 insulating layer comprises a silicon nitride layer, a
3 silicon carbide layer, a silicon carbonitride layer, or a
4 silicon oxycarbide layer.

1 12. A method for capping over a copper layer,
2 comprising the steps of:
3 forming the copper layer overlying a substrate;
4 treating a surface of the copper layer with a hydrogen-
5 containing plasma;
6 treating the surface of the copper layer with a
7 nitrogen-containing plasma; and
8 capping the copper layer with an insulating layer.

1 13. The method as claimed in claim 12, wherein the
2 surface of the copper layer is treated with the hydrogen-
3 containing plasma at about 300 to 500°C.

1 14. The method as claimed in claim 12, wherein the
2 surface of the copper layer is treated with the hydrogen-
3 containing plasma for about 5 to 15 seconds.

1 15. The method as claimed in claim 12, wherein the
2 surface of the copper layer is treated with the hydrogen-
3 containing plasma at a pressure of about 3 to 6 Torr.

1 16. The method as claimed in claim 12, wherein the
2 surface of the copper layer is treated with the nitrogen-
3 containing plasma at about 300 to 500°C.

1 17. The method as claimed in claim 12, wherein the
2 surface of the copper layer is treated with the nitrogen-
3 containing plasma for about 5 to 20 seconds.

1 18. The method as claimed in claim 12, wherein the
2 surface of the copper layer is treated with the nitrogen-
3 containing plasma at a pressure of about 2 to 4 Torr.

1 19. The method as claimed in claim 12, wherein the
2 insulating layer comprises a silicon nitride layer, a
3 silicon carbide layer, a silicon carbonitride layer, or a
4 silicon oxycarbide layer.

1 20. A method for forming a copper interconnect,
2 comprising the steps of:
3 providing a substrate covered by a dielectric layer;
4 etching the dielectric layer to form an opening
5 therein;
6 filling the opening with a copper layer to serve as the
7 copper interconnect;
8 treating a surface of the copper layer with a hydrogen-
9 containing plasma;

10 treating the surface of the copper layer with a
11 nitrogen-containing plasma; and
12 forming a capping layer on the dielectric layer and the
13 copper layer.

1 21. The method as claimed in claim 20, wherein the
2 opening is a dual damascene opening.

1 22. The method as claimed in claim 20, wherein the
2 surface of the copper layer is treated with the hydrogen-
3 containing plasma at about 300 to 500°C.

1 23. The method as claimed in claim 20, wherein the
2 surface of the copper layer is treated with the hydrogen-
3 containing plasma for about 5 to 15 seconds.

1 24. The method as claimed in claim 20, wherein the
2 surface of the copper layer is treated with the hydrogen-
3 containing plasma at a pressure of about 3 to 6 Torr.

1 25. The method as claimed in claim 20, wherein the
2 surface of the copper layer is treated with the nitrogen-
3 containing plasma at about 300 to 500°C.

1 26. The method as claimed in claim 20, wherein the
2 surface of the copper layer is treated with the nitrogen-
3 containing plasma for about 5 to 20 seconds.

1 27. The method as claimed in claim 20, wherein the
2 surface of the copper layer is treated with the nitrogen-
3 containing plasma at a pressure of about 2 to 4 Torr.

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- 1 28. The method as claimed in claim 20, wherein the
- 2 insulating layer comprises a silicon nitride layer, a
- 3 silicon carbide layer, a silicon carbonitride layer, or a
- 4 silicon oxycarbide layer.